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# SCIENCE

FRIDAY, APRIL 4, 1919

## MEDICINE AND GROWTH<sup>1</sup>

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DOUBTLESS friends have congratulated you on the fact that you were "through." In one sense—a strictly academic sense—that is true, else you would not be here, subject to this ordeal. But perhaps there is another way of looking at the situation. The Greek philosopher, Pyrrho, contended that against every statement the contradictory may be advanced with equal reason, and following this estimable skeptic, I feel justified in the assertion that, as a matter of fact, you are not "through," but rather are just commencing doctor of medicine, if one may give the word commence its older meaning.

You have qualified for a degree—a degree which entitles you to membership in a learned profession—that, like the church and the law, has the distinguishing responsibility of dealing with matters of life and death.

A profession makes heavier claims on its representatives than does a trade or an art, for in the nature of the case it demands continued progress, and it is part of the unwritten law that those who enjoy the prestige which such a position brings, should leave their profession better than they found it.

To do this implies progress—progress by growth, and it is the idea of growth that I wish to use as a guiding thread for the conduct of this talk. It is my purpose then to say a word concerning growth as it affects that very important person, the patient; then to speak of growth as it touches the body of medical knowledge; and finally to consider growth as it affects the physician in his riper years.

To follow an old time form let me announce

<sup>1</sup> Address to the graduates of the Medical Department of New York University. Delivered at the special commencement exercises, held at University Heights, New York, on Saturday, March 1, 1919.

my first thesis, namely: that a patient is always changing, growing.

Johannis Bernoulli, a member of the most remarkable family of mathematicians of which we have a record, published in 1699 a thesis in which he maintained the continual change of substance of the body.

His argument drew the theological lightning of his day, and he forebore to push his studies further, but his ideas were passed along, and I know that in my youth no self-respecting popular physiology failed to repeat the statement that the human body underwent a complete change of substance once in seven years.

We look at matters somewhat differently today but it is not without interest to record that this idea of change started under such eminent patronage. The modifications due to growth are another matter, yet the idea of growth, despite the universality of the phenomenon, has been only gradually assimilated and put to use.

In earlier times growth was but little considered. We need not go back very far in medical history to find that the typical patient was the person already grown. The patient was thus standardized.

The young were dealt with by midwives and grandmothers, and the aged took care of one another.

Speaking in the broadest way the physician's business was to care for that mythical person, the average man, to whom the recorded facts of anatomy and physiology all applied; for the phases of growth were not then regarded in these disciplines, and medicine shared with art and education a curious blindness to developmental changes. Great advances have occurred. We now have those clinicians who give special care to children, to adolescents or to the aged.

The relations of age to the incidence of disease, as in the children's diseases, in typhoid or in cancer, have directed attention to progressive alterations within the individual, a series of changes which are quite aside from the marks of maturity or the signs of old age.

Thus men of a given race pass through a

series of well recognized phases and, as in a set of dissolving views, infancy merges into childhood and childhood is transformed to youth, and so within the span of life we have revealed the seven ages of man, so quaintly sketched by Shakespeare.

Familiar as these phases are it has taken no small labor to bring them into the field of practise and to have them recognized as of clinical importance. There is the same difficulty here that appears in carrying over to our laboratory work the ideas of variability and of graded relationship which were developed by Darwin and those who followed in his steps.

We know that individuals differ in their form and anatomy, but we wish they didn't; it would be so much easier if they were all just alike.

We know, too, that what is true of structure is also true with regard to the functions of the body. Here the facts are harder to appraise, and there is a still stronger tendency to dodge them. But this avails us nothing. The facts will find us out—and moreover they are unpleasantly immortal.

The idea which I wish to drive home is this: During the span of life the body shows changes more or less like those shown by a battered ship or neglected automobile, but behind these lies a set of changes which no dead structure or machine exhibits, a progressive chemical alteration of the body linked with age, probably affecting all its parts, and constituting the series of modifications characteristic for the individuals of any species, as these pass from birth to senile death.

The mechanism which prepares our food; that which distributes the food-bearing blood; the nervous system which controls our behavior; the muscles which do the work, and the internal secretions from the ductless glands and other sources which serve to tune or tone our organs, all these undergo with age changes not only in themselves but in their relations to one another.

On the balance of these component parts depends that somewhat subtle character called

temperament, which though elusive, has a real existence and an importance hard to over-estimate. Temperament is the expression of these relations and one of the nice problems the clinician has to face.

Under certain circumstances it makes a difference whether one has light hair or dark, not because these characters are themselves important, but because they are indicative of subtle dissimilarities in the chemistry of different individuals, dissimilarities which are of far-reaching importance for the individual as a whole.

Recently it has become possible to do our laboratory work with animals the ages of which are known. Working thus we find at every turn differences, distinct and definite, dependent on the age, differences which should be studied, for without shadow of doubt they will be found in man when search for them is made.

I make no question that much of what I have just said to you has a familiar sound, but the time is coming, I feel sure, when the significance of age will be appreciated in many fields where now it is but little noted, as for example in the blood, and I have spoken thus to specially direct your thought to these matters.

Thus far the individual who is growing normally and who represents the usual case has been considered. In passing, however, it may be worth while to turn for a moment to the individual subjected to starvation. The terrible years through which the world has just passed have brought starvation vividly before us. We know that in starvation growth is modified and may apparently be stopped.

As in so many other instances our knowledge of the changes thus induced is still fragmentary and incomplete. In the first place we must distinguish between the starvation which follows when the quantity of an adequate diet is made unduly small, and the case in which the diet is unbalanced and defective in itself, and therefore only slightly modified by quantitative variation. It is the former case to which I would draw attention here.

If we may trust the tests with animals, two systems tend strongly to resist mere quantitative underfeeding—the skeleton and the nervous system. Growth in them is greatly retarded to be sure by underfeeding, but they may still grow, while the body as a whole is held at a constant weight or is even losing.

The practical question before us however is not so much the immediate effects of starvation, as the response which such an animal will make when it is brought back to a full and normal food supply.

The nervous system is best known to me and I think we may say with regard to this system that a return to the normal diet is followed by nearly, if not quite, complete recovery. This is a cheering and hopeful result and yet, as always, a word of caution is in place. Starvation, as followed in the laboratory, can be studied free from the complicating conditions of the exhausting systemic diseases, so often associated with starvation in human communities, and what is true for the simple conditions of the laboratory may not be true for those which are more complex.

Nevertheless in these days, when underfeeding is much in evidence, it is of interest to note that one form of it at least does not cause permanent damage to the great master system of the body.

The life histories of many students and productive scholars support this conclusion, for biographies show only too frequently, periods of starvation in the lives of those who, then and later, were distinguished for intellectual activity.

Thus far I have been speaking of growth as it modifies the patient, when that long-suffering person is looked at as a biological problem.

Now let me pass to the second topic and ask you to consider the growth of medical knowledge.

The mass of knowledge in any subject may be likened to a sphere which is rolled on from generation to generation, always growing by additions on the surface.

All of us, as scholars or investigators, are entrusted with its preservation and its in-

crease, but like the sacred beetles that also have their sphere, we often roll our load with clumsy slowness and humorous mishaps. Nevertheless this sphere contains our intellectual pabulum and is worth close scrutiny.

In the first place it is to be observed that like the moon the apparent size of this sphere is highly variable. When we first view it in the early student years it appears to have moderate dimensions. Later it seems enormous, but as the years go on it shrinks once more, and I venture to think that in this last phase our impressions correspond more nearly to reality.

An analysis of this experience may be worth while. The mass before us is typified by all that has been written plus the traditional wisdom which is handed down from teacher to pupil. When the written records are examined it becomes evident that the greater portion of them are formed by an enormous accumulation of evidence and arguments for a relatively small number of important conclusions, and also for a multitude of hypotheses which have perished by the way.

Did you ever go into a well-stocked library in which the books dealing with a given subject were arranged in their historical sequence, and then ask yourself what could be said of these—what was their larger meaning? It is worth doing. One can, of course, dismiss the greater number as out of date, a few only have the power to remain alive. Yet all these books, or nearly all, passed through a period when they were consulted and esteemed.

It is plain that most of our medical literature, including that which represents the fundamental sciences, is concerned with the presentation of evidence and arguments for some point of view. In the end the conclusions can be stated in a few words. When these conclusions are established and made certain, much of the literature developed by the way becomes of historic interest only, to be treasured and preserved of course, but removed from the field of central vision.

Thus when malaria was shown to be due to pathogenic organisms—insectborne—the ante-

cedent literature concerned with other theories of its etiology ceased to be instructive.

One result of recognizing such a change is to make the sphere of knowledge seem less ponderous, yet it is never a small matter, and there is always with us the question how we can best handle this load of learning. In many cases it is necessary to carry only a skeleton outline of the existing knowledge, yet one must be ever ready to follow a subject into all of its details, when the occasion demands.

All this takes time and time presses ceaselessly. Always we have with us the stubborn fact that three score and ten years make a full life, and that although the day may be shortened by legislative action, no hours can be added.

Joseph Leidy, the distinguished naturalist, once said that he could carry some 20,000 names in mind, but if new ones were to be acquired, some of the old ones must be forgotten.

This is a somewhat cryptic saying and invites psychological analysis, but it also serves to direct attention to the limitations which beset even those exceptionally endowed. Apparently we only carry those facts which from time to time can be recalled. Neglect them and they get lost: like foraging pigs they must be called in now and then or they will forget the way home.

This sphere of learning which we have in view is composed of facts that date from many centuries. Some are surely very ancient, and strictly new ideas are hard to come by. Our classical friends are fond of pointing out that many ideas which we parade today were known to the Greek philosophers 2,000 years ago. Of course if persons make a business of thinking, as did this group among the ancients, they are bound to reach a number of more or less logical conclusions, though some of them may be quite contradictory. It was not until such rival conclusions could be put to the experimental test that it was possible to sift the true from the false, and therefore our biological science deals with no small number of ancient ideas

and the contribution of the modern workers is the selection of those which can survive the trial. As the expression goes: we test the hypothesis. Ideas which can survive the blows and buffets of time have a certain prestige and dignity which is to be reckoned to their credit, while the number born to perish, those that appear but once, are as the eggs of a fish. Moreover, it is most important for us in weighing the worth of ideas to know something of their history—I might almost say their ancestry—and not to confuse the unbaked results of the hour with those that have an ancient lineage. If we realize then the persistent character of all first-class problems, it ceases to be a wonder that when the results of an investigation are followed back into the literature, some of them may be found foreshadowed there or even definitely formulated, sometimes on good grounds, sometimes on bad.

Of course there are critical points in the advancement of knowledge which, when passed, make possible conclusions that are plainly novel and could not have been reached before. The aspect of medicine changed after Harvey discovered the circulation of the blood. The heat of the body appeared in a new light after Lavoisier developed the theory of oxidation. Galvani's observations on the nerves and muscles of frogs gave a new idea of the nervous impulse, and Johannes Müller's doctrine of the specific energies of nerves revolutionized our notions of the sense organs. Infectious disease suddenly became intelligible in the light of the work of Pasteur, and the doctrine of internal secretions and the chemical messengers, taking its departure from the observations of Brown-Sequard, shed a world of light on the control of body functions and relieved the nervous system from responsibilities which were proving too heavy for it.

If then we come back to our sphere of knowledge and endeavor to see in what manner it is compounded, we find in it ideas which repeat themselves at every revolution. We find great masses of information which, because they have served their purpose in establishing points of view, now have mainly an historical interest, and overlying all, most con-

spicuous and best known is the newer knowledge, the kind you have just labored to acquire, composed of these elements in part but in larger part consisting of detailed evidence, valuable for the newer points of view.

It requires some skill to manipulate this mass of information without being smothered by the dust of it, but handbooks, summaries, digests, reviews and journals deal with it in such a way that one can get their bearings with a comparatively small expenditure of time.

There still remains the question how this information by which we live should be regarded. There have been communities and times when medical learning was handled almost as a trade secret, indeed the Hippocratic oath suggests that this idea was an ancient one. It was as though the possessor had acquired a fixed and rigid formula for making a peculiarly good article useful to the public, but the production of which should be protected. This attitude has been abandoned happily, save in the most backward communities and among the least intelligent practitioners. The modern and the progressive view is quite different. It is in harmony with the response of John Hunter the great comparative anatomist, when some one quoted to him a statement which he had made a year before. "Sir," he replied, "I am not to be held by my statements of a year ago." He had progressed in the interval and he had accordingly changed his opinion. The knowledge which has been presented to you, and to which you have added by your own industry, is to be sure the best available at the moment, but that is the most that can be said of medicine and the most that can be said of any science. If we believed otherwise, if for a moment we thought of it as fixed and final, those of us at least who work in laboratories would promptly go into the chrysalis stage and somnolently wait for immortality. That however is not done. To-day the best use possible is made of such information as we have been able to gather, but with the confident expectation that to-morrow will bring new knowledge. Look at the extension of our

notion of the ether familiar to most of you in the Röntgen rays, or the sudden widening of the chemical horizon by the discovery of radium and the analysis of the atom into its constituent electrons. These new ideas make the older men to think, a painful process, and, because painful, avoided if possible.

Now, even in medicine, there are difficulties of this sort which create a somewhat trying situation.

I have been appalled by the apathy of some of my medical friends towards the experimental work which goes on in the laboratory. We need encouragement and protection in the laboratories, especially for such work as involves the study of the living animal. Vivisection this is called by those who oppose the study of the living animal—but as there is no essential difference between this work and either surgery or medicine—by the same token both surgery and medicine are vivisection. So we may compromise, and speak of this operative work as animal surgery or medicine. Many studies require to be made on the living animal but here in this community, and those communities in which my lot has been cast, such study is often strenuously opposed by some who will not see its value. I had supposed that my clinical friends, representing as they do the most influential group of professional men at the present day, would rise in a body and say *this work is necessary for our progress and the advancement of our profession*—but they did not. I tried to find out why.

Various reasons appeared—some of which may occur to you without my mention of them—but the one which arrested my attention was a sort of mental inertia, a dislike of change and of the labor of rearranging old ideas to meet the new conditions consequent on new advances. It was argued too that the laboratories were often misleading and that discoveries were put forward for general use long before they had been tested and retested with the caution that the case demanded. Reference was made to the famous instance of tuberculin, for which Koch appears to have been really less responsible than those who at

the time dictated his utterances. The criticism is, however, in a measure just. I am painfully aware that in the laboratory a remoteness from real life sometimes weakens the sense of responsibility for results which are put forth, but these last decades, and especially the very last, have shown a vast improvement in this relation and the cooperation between the clinic and the laboratory has become most happily intimate.

I have spoken of the laboratory because it is an important source of knowledge for the clinician, though most naturally farthest removed from his daily experience. I ask you to remember that one may help medicine and yet do it as a chemist, a botanist or a zoologist—quite detached from the clinical applications of what is found. To grow pathologic organisms is a biological problem; to follow insect borne diseases takes one into entomology. The applications to medicine are incidental, but often of the greatest import. Remote then may be the sources of facts important for the practitioner, but, although they are remote, these sources should be neither forgotten nor neglected.

Though your knowledge is the best at the moment, yet to-morrow may see a change for the better by the introduction of some advance based on what is now an incidental laboratory test or clinical observation—yet to be applied. For the protection of this laboratory work not only your interest but your moral and professional support is needed.

I have dwelt on the fact that the patient is a different individual at different ages, and that your knowledge and ideas must change and grow with the continued pondering of experience. In that connection there is just one word to add. It touches growth in the physician himself—a very vital matter.

The intelligence tests about which much controversy has been waged during the past ten years have come to stay. They sometimes are disquieting. It is said that an intelligence of nine years suffices to rear and bring up a child. I do not know just what mental age admits one to the laboratory. Though further applications to the problems before you are

not needed here, yet I do want to point out that these tests show in a somewhat precise way a fact that can hardly have failed to strike us all, namely, that our associates stop growing mentally at quite different ages, some continuing to grow long after others have reached their limit.

When Cato learned Greek at eighty years it indicated more than that the farm was doing well and he had time to spare. It indicated a capacity for new interests and a mental retentiveness which are among the virtues of the youthful mind.

These are endowments which we would all desire but which are unevenly possessed. However, in any discussion which involves the problem of nature versus nurture, it can always be pointed out that whatsoever nature has or has not done, there still remains the possibility of modifying nurture—or the environment—and these possible modifications are worth attention.

Observation shows us that the differences between men are small, but that, small as they may be, they amount to a great deal. Slight improvement is worth a struggle and repays the effort. I am commending to you therefore the effort to keep growing mentally.

A remarkable example is that of Helmholtz.

Helmholtz began as a physician—a very mediocre practitioner they say—but under the inspiration of Johannes Müller he became interested in physiology. This branch he followed by the study of the eye and ear, leading to his great works on physiological optics and sensations of tone—by the way devising that important instrument the ophthalmoscope. But the physiology of the sense organs called for physics. So well did he follow this lead that he became one of the first physicists, and linked his name with the doctrine of the conservation of energy. Still going forward he developed his mathematics and became eminent in that field also. Here is a steady growth through a long life. A great intellectual engine at his command was applied to field after field in succession, and always with a resulting advance in knowledge.

Such men set the pace and these pace-

makers are the most helpful members of our race, for while those who have stopped growing have but a single response, "It can't be done," the pace-makers do it.

Naturally you ask what is the formula, how is it accomplished? Let me reply by a question: What do you think about when you are not working? For most of us that period represents the larger part of life, and it does make a difference what we do with this great fraction, so I will leave the implications of my question without elaboration, but ask you to meditate upon it.

There is however a further matter which lies closer at hand. Let us consider the "Bohemian." I mean the individual who bears this name by virtue of his behavior. He is worthy of attention. He protests against the restriction of conventions, sometimes in a not too seemly manner, but at his best with the hope of getting free from conditions which hamper thought or work. We all suffer from these restrictions in a mild way. By all accounts the savage seems to be most completely surrounded by taboos and conventional restraint. His is not a happy lot. Civilized man suffers less, and yet conventions stand in our way.

The necessity of getting back for dinner cuts into an experiment. The idea that one retires at a certain hour limits a series of observations. Very trifling these conditions, you will say, yet breaking life up into small lengths in a way which often interferes. War teaches us something here that may be useful.

In this connection I love the story of von Baer. Von Baer, the embryologist, tells how he went into his laboratory when the leaves were falling in the autumn and came out again when the spring flowers were in bloom. That was a day's work that counted, and we can do well to ponder on it. Von Baer was the sort of Bohemian I have in mind.

Here I rest my case.

The past four years have meant great things for medicine. For the first time in history the fighting man has had the best that medicine could give. Certain forms of practise have advanced by leaps and bounds, and you



come into action when medicine still feels the impulse of these strenuous years.

The laboratory and the clinic have collaborated as never before and the future is full of promise.

Under these conditions it has been my privilege to give you encouragement and a bit of counsel, and I feel indebted for the opportunity.

HENRY H. DONALDSON

#### WILLIAM ERSKINE KELLICOTT

A CONSTANTLY lengthening list of scientific men who have surrendered their lives in varied war services, or in that harder, more exacting fight with microbial enemies, is one of those news columns which our eyes have come to scan with a strange mingling of suspense and unwilling, silent complacency. The world, and each of us in it, has become immeasurably poorer because of this great drain upon potential mental energy; and the lost men, as a rule, have had capacities for friendship directly commensurate with their intellectual powers.

Not a few American zoologists were particularly moved by a recent item of this sort; and to the list we are now compelled to append the name of William Erskine Kellicott, who was taken away by pneumonia, after illness of a week, at his home, in Hastings-on-Hudson, N. Y., January 29, 1919. Though but forty years of age, he, among scientists, teachers, critics and friends, had become to many their great, to some their greatest, satisfaction.

His career may be briefly summarized as follows: he was born in Buffalo, N. Y., April 5, 1878, the son of David Simmons Kellicott and Valeria Erskine Stowell. His father, at that time, was head of the science department in the Buffalo State Normal School. His earlier educational training was received entirely at home, so that he began his high school studies, at the age of twelve years, directly from his mother's tuition. This occurred at Columbus, Ohio, the second year of his father's appointment to the chair of biology in Ohio State University. After completion of his high school course, he entered the university, from which he received the degree of Ph.B. in 1898, with election to Sigma Xi. Later, on organization of a chapter

of Phi Beta Kappa at Ohio State, he was chosen to that society also.

His undergraduate work was shaped and pursued with entire reference to a future career in surgery; but his father's death in his senior year changed this cherished plan, and he spent his first post-graduate year in teaching biological subjects in the high school at Marysville, Ohio. The following summer he was a student in the invertebrate zoology course at the Marine Biological Laboratory, Woods Hole, Mass., and it was at this time that Kellicott decided to devote his energies to zoological science. In the autumn of 1899 he began graduate study at Columbia University, and received the doctorate in 1904, his major thesis being entitled "The Development of the Vascular and Respiratory Systems of *Ceratodus*."

The following positions were occupied by him for the term of years indicated:

In Barnard College, assistant in zoology, '01-'02; tutor, '02-'05; instructor, '05-'06.

In Goucher College, professor of biology, '06-'18.

In College of the City of New York, professor of biology, '18-.

In the Marine Biological Laboratory, instructor in embryology, '11, '12, '14; in charge of the embryology course, '15-.

For the year 1912-13 he was fellow of the Kahn Foundation for the Foreign Travel of American Teachers, and as such was enabled to visit many European countries and numerous centers of interest in Siberia, China, Japan and India. His report to the foundation offers interesting proof of his discriminating analysis of human nature.

In July, 1918, he resigned as assistant statistician of the U. S. Food Administration, having served one year; during this time he devised and put into operation a thorough and efficient system of gathering data from dealers in food all over the country, definitely stamping the square dealer and the profiteer.

He was a fellow of the American Association for the Advancement of Science, a member of the American Society of Zoologists, of the American Naturalists, and of the New York Academy of Sciences.